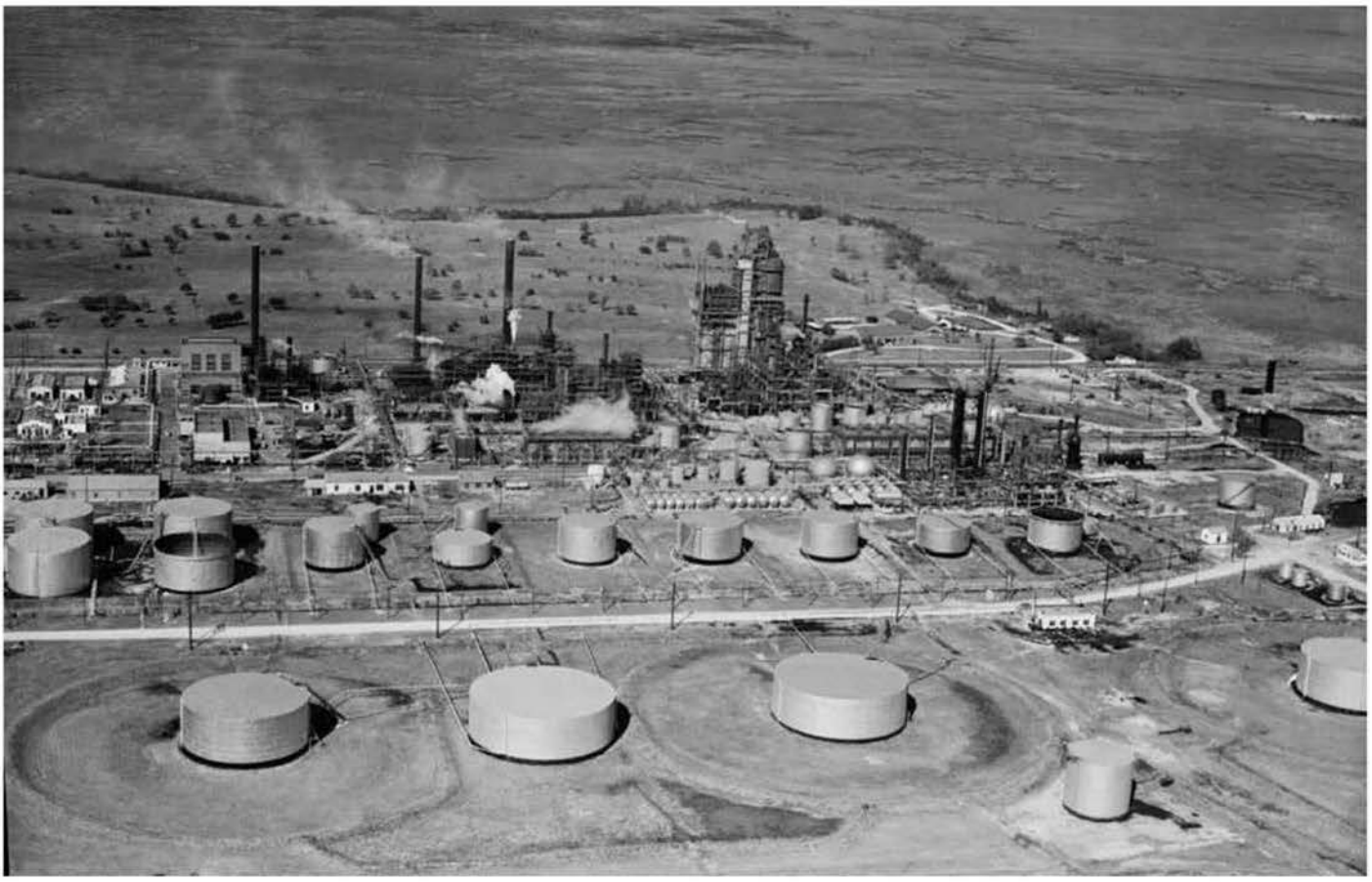
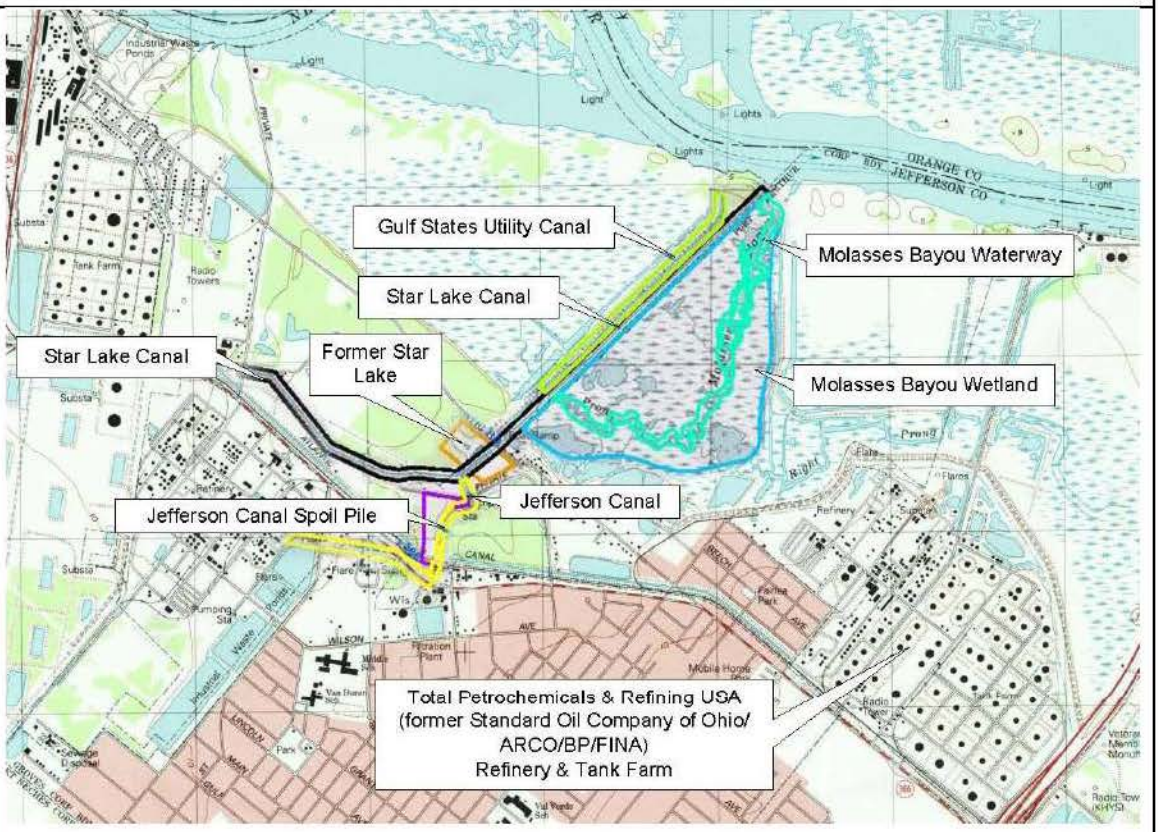
Preliminary Nexus Summary
For
ARCO – BP Oil Corporation



Source: SMU Central University Library, Robert Yarnell Richie Photograph Collection, Atlantic Refining Co., Atreco, Texas; Aerial 11/53; #3906-1

Table of Contents

Part I – Site Summary Overview – BP Oil Corporation	
Refinery Operational Period	1936 to July 1973 The Atlantic Refining Company; Atlantic Richfield Company ("ARCO"); Standard Oil Company of Ohio ("Sohio"); and BP Oil Corporation[1]
	 Figure 1. The topographic map depicts the BP Refinery (former ARCO/FINA Refinery & Tank Farm) in relation to the seven highlighted areas of interest ("AOIs") in the Star Lake Superfund Site.[2] Source: USGS, 1993
Nexus Summary	BP Refinery discharges containing CERCLA-listed hazardous substances, contributed to contamination present in the Star Lake Canal Superfund Site and the Molasses Bayou Waterway and Molasses Bayou Wetlands Areas of Interest ("AOI") in particular.

[1] For the purposes of this summary, the refinery will be referred to as the "Site or BP Refinery".

[2] The seven AOIs, as depicted in Figure 1, include Jefferson Canal, Jefferson Canal Spoil Pile, Former Star Lake, Star Lake Canal, Gulf State Utility Canal, Molasses Bayou Waterway, and Molasses Bayou Wetland (Conestoga-Rovers & Associates and Cardno ENTRIX, *Final Tier 2 Remedial Investigation Report*, August 2011, pp. 12–14; USEPA, Region 6, *Record of Decision: Star Lake Canal Superfund Site*, September 2013, pp. 1–3).

Part 2 – Summary of Key Information

Operational Chronology:

between March 1936 and March 1937

- The Atlantic Refining Company began operating a refinery on the Site.[3]

as of 1941

- The refinery had a crude oil throughput capacity of 20,000 barrels per day ("bpd"). It produced motor gasoline and fuel oils.[4]

1944

- The Atlantic Refining Company added a fluid catalytic cracking unit to the refinery.[5]

1956

- The Atlantic Refining Company added an alkylation unit to the refinery.[6]

1957

- The Atlantic Refining Company added a reformer to the refinery.[7]

1959

- The Atlantic Refining Company added a natural gas processing plant to the refinery.[8]

1962

- The Atlantic Refining Company added a crude unit to the refinery.[9]

as of 1967

- The refinery's processing units included a crude still, a thermal visbreaker (cooled with about 3,000 gallons per minute of Neches River water), one fluid catalytic cracking unit, two catalytic reformers, a hydro-desulfurizer for distillate fuels, an alkylation unit for gasoline production, a propylene polymerization and polymer fractionation unit, a sulfur recovery unit, a caustic wash unit, and a detergent alkylate unit. It produced gasoline, specialty naphthas, kerosene, distillate fuels, residual fuels, detergent alkylates, and LPG.[10] The refinery had a crude oil throughput capacity of 84,000 bpd.[11]

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[3] Port Arthur Centennial History, 1898–1998, p. 92; "Refineries Operating in United States," *Oil and Gas Journal*, March 19, 1936, p. 167; "Refineries Operating in United States," *Oil and Gas Journal*, March 25, 1937, p. 178.

[4] Moody's Manual of Investments: Industrial Securities, 1941, p. 2209; "Refineries Operating in United States," *Oil and Gas Journal*, March 27, 1941, p. 191.

[5] Port Arthur Centennial History, 1898–1998, p. 92.

[6] Port Arthur Centennial History, 1898–1998, p. 92.

[7] Port Arthur Centennial History, 1898–1998, p. 92.

[8] Port Arthur Centennial History, 1898–1998, p. 92.

[9] Port Arthur Centennial History, 1898–1998, p. 92.

[10] Marshall Elliott and Larry Smaihall, Atlantic Richfield Refining Co., Industry Survey, November 1, 1967.

[11] "U.S. Refineries: Where, Capacities, Types of Processing," *Oil and Gas Journal*, April 3, 1967, p. 198.

Part 2 – Summary of Key Information

1968

- ARCO sold the refinery to Standard Oil Company of Ohio. As of January 1, 1970, BP Oil Corporation, a subsidiary of SOHIO, operated the refinery.[12]

1970–1972

- BP Oil Corporation improved the Refinery's wastewater treatment facilities.[13] See Part 6 for a description of the improvements.

July 1973

- American Petrofina acquired the refinery from Sohio.[14]

Part 3 – Permits

Texas Industrial Wastewater Discharge Permit

On March 4, 1963, the Texas Water Commission issued to Atlantic Refining Company industrial wastewater discharge permit No. 00491.[15] Effective April 24, 1969, the permit was amended. The amended permit required BP Oil Corporation to remove domestic sewage from the waste stream and improve its wastewater treatment by installing aeration and surge basins by July 1, 1970. A second phase of improvements, to be implemented by December 31, 1972, would extend the aeration process with the addition of a clarifier, sludge recycling, and aerobic digestion.[16]

Part 4 – Complaints, NOVs, Consent Orders, Enforcement Actions

None documented. Trade literature indicates that during refinery operations (*e.g.* distillation, thermal or catalytic cracking, reforming, alkylation, polymerization, isomerization, chemical treating, solvent refining, etc.) oily wastes are routinely released from plants to sewers at various locations. These releases can occur because of leaky connections, pump leakage, spills, line breakage, and the like. Large volumes of oil may be released during emergencies or scheduled shutdowns, equipment cleaning, or unit start-ups. Leaks and spills can occur during product transfers, tank overflows and by accidental opening of valves. Tank cleaning activities can involve steam, which when it condenses will contain oil and sediment. If the waste is allowed to accumulate on the ground, the oil may gradually seep into nearby surface waters.[17] Given the timeframe of BP's operations, the absence of documented complaints and NOVs is not an indication that routine spills and releases did not occur at the BP Refinery.

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[12] Port Arthur Centennial History, 1898–1998, p. 92; Moody's Industrial Manual, 1972, vol. 2, p. 2537.

[13] BP Corporation, Industrial Wastewater Discharge Permit No. 00491. An undated map depicts the proposed location of the wastewater treatment plant.

[14] Moody's Industrial Manual, 1990, vol. 1, p. 2571.

[15] BP Corporation, Industrial Wastewater Discharge Permit No. 00491.

[16] BP Corporation, Industrial Wastewater Discharge Permit No. 00491.

[17] American Petroleum Institute, *Manual on Disposal of Refinery Wastes, vol. 1, Waste Water Containing Oil* , 6th ed., (1959), p. 11–13.

Part 5 – Environmental Studies or Investigations

Additional regulatory agency requests have been submitted for additional materials.

Part 6 – Pathway

Figure 2 depicts the approximate locations of outfalls and other features discussed below.

The earliest documentation of the existing discharge system being in place at the Site dates to 1967. Based on topographic maps and aerial photographs, however, infrastructure that carried process, storm, and sanitary flows appear to have been in place from at least 1943 and continue to appear on aerial photographs from 1953 and 1956. See Figures 3-5. These figures are being used in this section to illustrate the fact that features discussed in reports from the 1960s were present during earlier timeframes.

The primary effluent discharge pathways for the BP Refinery, relevant to this matter, are a 16-foot-wide ditch cut through the marsh ("North Ditch"), a feature referred to as the Motor Boat Canal, and three outfalls (Outfall 001, Outfall 002, Outfall 003) located proximate to the North Ditch and Motor Boat Canal. A fourth outfall (Outfall 004) is located on the easterly side of the refinery. Discharges from Outfall 004 do not appear to reach The Star Lake Canal Superfund Site. See Figure 2.

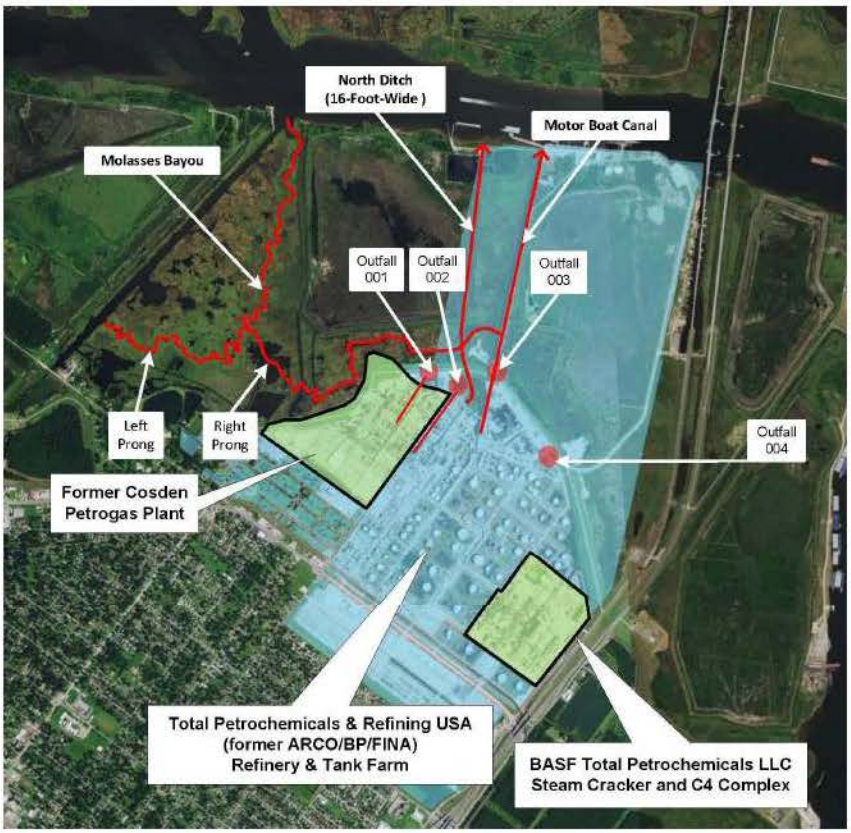

Figure 2. All feature locations are approximate.

Source : ESRI, 2016

Part 6 – Pathway

As described in a 1967 Industry Survey, wastewater associated with the BP Refinery discharged to the Neches River through the North Ditch. Two waste streams within the process area ultimately discharged to this feature: 1) the North Ditch received about half of the BP Refinery's storm water, once-through cooling water, sludge from a clarifier, regeneration waste from softeners, boiler blowdown, and process and wash-up waste from the crude still; and 2) some 300 yards into the marsh that lay between the BP Refinery and the river, the North Ditch intersected with a so-called Accellator Outfall, which received all other process waste, cooling tower blowdown, and some storm water. This combined stream (North Ditch and Accellator Outfall) contained practically all of the oily wastes from the Site. The waste stream passes through an earthen pit separator to remove oil and settleable solids. The water from the separator discharged to an Infilco Accelator, which treated the wastewater with alum floc. Sludge from the Accelator was pumped to a large pit in the marsh. As of 1967 the unit had been in service for 10 years.[18] A 1956 aerial photograph depicts a large area of distressed vegetation proximate to the right prong of Molasses Bayou, which may be the Accelator clarifier disposal pit. See Figure 5.

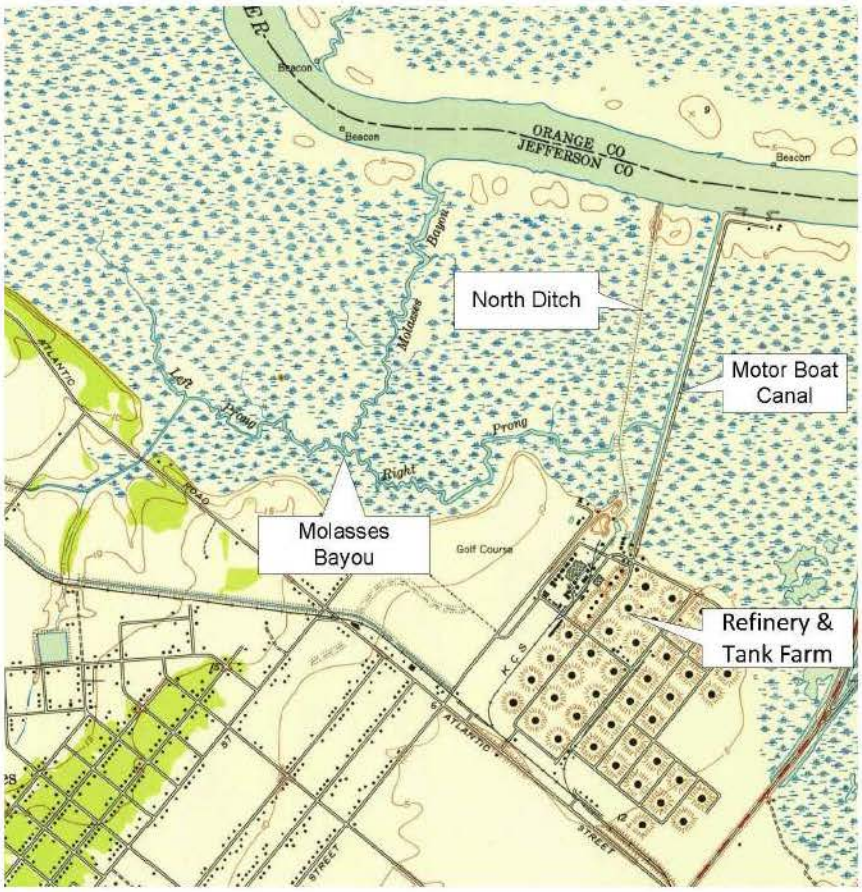

Figure 3.

Source: USGS 1943

Note: The locations of the Accelator Outfall and the sludge pit are not clear from the source document and therefore are not shown on the figure.

[18] Marshall Elliott and Larry Smaihall, Atlantic Richfield Refining Co., Industry Survey, November 1, 1967. It should be noted that the manufacturer of the Infilco system spelled "Accelator" differently in promotional advertisements than the author of the above referenced memorandum. Indeed, during the 1930s, Infilco trademarked the Accelator name. See, Library of Congress, *Catalog of Copyright Entries*, Third Series, 1957, p. 1204; Infilco, Inc., *The Accelator Treating Plant* Bulletin 1825 (1955).

Part 6 – Pathway

According to the 1967 Industry Survey, wastewater associated with a Demineralization Unit, which alternated between diluted sulfuric acid and diluted sodium hydroxide, discharged to the marsh between the BP Refinery and the river via a so-called Country Club Ditch, which ran through company-owned vacant property north of the processing units.[19] This outfall would later be referred to as Outfall A and still later as Outfall 001.

An amended wastewater discharge permit with an effective date of April 24, 1969, described the BP Refinery's outfalls as follows: Outlet A (Outfall 001), an open drainage ditch, discharged storm water runoff into the marsh; Outlet B (Outfall 002), an open drainage ditch, discharged untreated, once-through cooling water into the marsh. Both of these streams discharged to the marshy area and/or traveled to the Molasses Bayou Waterway. Outlet C (Outfall 003) discharged treated process waste streams through a 24" pipe to the Motor Boat Canal and then to the Neches River.[20]

As shown in Figures 3-6, the Motor Boat Canal was connected to the right prong of Molasses Bayou. The right prong of the Molasses Bayou crossed under the North Ditch.[21] Although available textual documents do not describe the conditions under which discharges to the Molasses Bayou occurred, it appears both features allowed refinery effluent discharges to reach the Molasses Bayou.

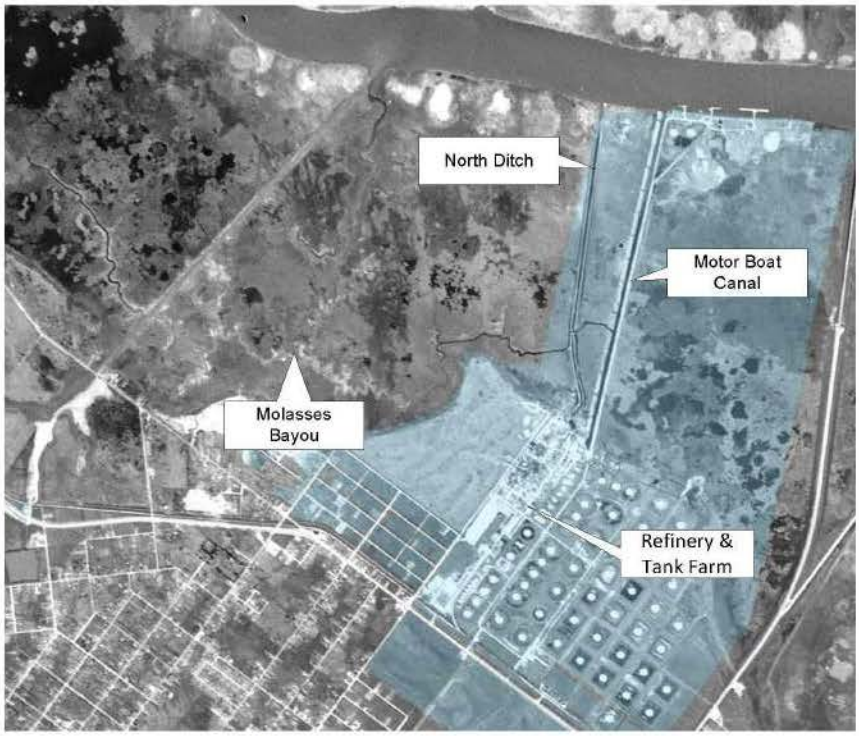

Figure 4. Source: USGS, 1952

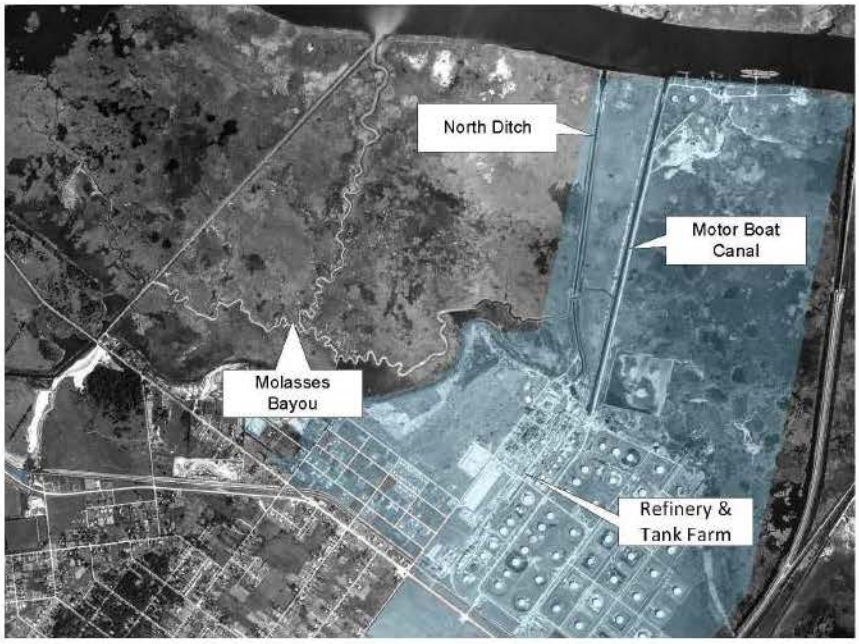

Figure 5. Source: USGS, 1956

[19] Marshall Elliott and Larry Smaihall, Atlantic Richfield Refining Co., Industry Survey, November 1, 1967.

[20] BP Corporation, Industrial Wastewater Discharge Permit No. 00491.

[21] The connection is also depicted in a figure attached to BP Corporation, Industrial Wastewater Discharge Permit No. 00491.

Part 6 – Pathway

Furthermore, Figure 6 depicts additional filling activity in the northeastern portion of the refinery site, near the marshland area, and the construction of waste disposal ponds proximate to the right prong of Molasses Bayou. The aerial also depicts two ditches leading from the facility to the right prong of Molasses Bayou.

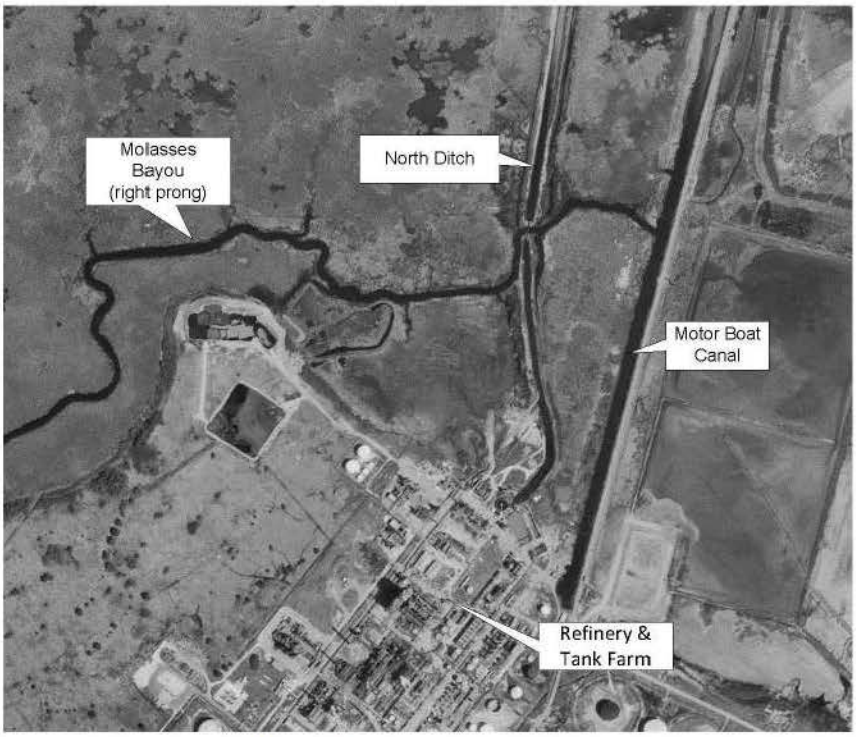

Figure 6. Source: USGS, 1970

Part 7 – Nexus Summary

BP operated the refinery from 1936 until America Petrofina acquired it in 1973. Effluent from the BP Refinery discharged to the Molasses Bayou and Molasses Bayou wetlands area from Outfall 001 from at least 1967 and from Outfall 002 from at least 1969. At least as of 1957, if not earlier, BP Refinery waste effluent was treated by an earthen-pit separator and an Infilco Accelator clarifier and then waste water was discharged to the North Ditch and ultimately to the Neches River.[22] Solids from this system were disposed of in a large pit in the marsh, proximate to the right prong of Molasses Bayou between the BP Refinery and the Neches River. Photographic evidence suggests that the North Ditch was connected to the Molasses Bayou from at least the early 1950s. Between 1969 and 1972, a wastewater treatment plant was built that included aeration, equalization, and surge basins, a sour water stripper, an API separator, a clarifier, a dissolved-air flotation unit, and a land farm. Storm water, which could comprise a large part of a refinery's waste waters, discharged to the marsh via Outfall 001.[23] Storm water, once-through cooling water which may itself have been contaminated, and treated tank farm runoff discharged to the marsh via an unlined ditch known as Outfall 002.[24] Wastes from Outfall 002 were later found to contain a variety of semi-volatile organic compounds

[22] Marshall Elliott and Larry Smaihall, Atlantic Richfield Refining Co., Industry Survey, November 1, 1967.

[23] American Petroleum Institute, *Manual on Disposal of Refinery Wastes, vol. 1, Waste Water Containing Oil* , 6th ed., (1959), p. 11–13; W. B. Hart, "Proper Classification of Wastes: First Step in Disposal Program," *National Petroleum News*, April 3, 1946, p. R-294 (quoted); idem, "Waste Oils Escaping to Surface Waters May Cause Many Kinds of Damage," *National Petroleum News*, June 5, 1946, p. R-468–R-469; BP Corporation, Industrial Wastewater Discharge Permit No. 00491.

[24] Hart, "Waste Oils Escaping to Surface Waters May Cause Many Kinds of Damage," *National Petroleum News*, June 5, 1946, p. R-467; BP Corporation, Industrial Wastewater Discharge Permit No. 00491.

("SVOCs"), and volatile organic compounds ("VOCs"), polycyclic aromatic hydrocarbons ("PAHs"), and metals.[25] Treated wastewater was discharged to the Motor Boat Canal at Outfall 003. As described in Part 6, the Motor Boat Canal was connected to Molasses Bayou. Effluent from Outfall 003 discharged to the Motor Boat Canal would have flowed (and/or overflowed during storm events) to Molasses Bayou, and was later found to include methylene chloride, phenol, chromium, toluene, and arsenic.[26]

Connection to the Star Lake Superfund Site

Based on available information, historical industrial wastewater and storm water discharges associated with the BP Refinery likely contributed to the contamination of both the Molasses Bayou Waterway and the Molasses Bayou Wetlands AOIs. The contributing pathway associated with refinery operations is the "right prong" of the Molasses Bayou Waterway, which joins the "left prong" of the Molasses Bayou Waterway within the boundary of the Molasses Bayou Wetlands AOI.[27]

The ROD divided the Site into seven AOIs.[28] The potential source area for the Superfund Site includes the impacted sediments of the Star Lake and Jefferson Canals and the Molasses Bayou.[29] Regarding the latter, the "left prong" of the Molasses Bayou Waterway is defined as the AOI under the ROD. As defined, however, the AOI extends downstream of the point of confluence of the left and right prongs of the waterway to the Neches River.[30] Discharges from the BP Refinery outfalls to the right prong of Molasses Bayou and marsh area, as well as other operations such as the disposal of solid wastes in the marsh area, provide pathways to the Star Lake Superfund site. The following discussion of sampling results illustrates this connection between the pathways and the Superfund site, but should not be interpreted to be the only sampling information that links the refinery effluent discharges to the Superfund site.

Surface water samples were collected from numerous on the Molasses Bayou during the Remedial Investigation ("RI"). PAHs, SVOCs, VOCs, and metals were detected in multiple samples. SVOCs and VOCs were detected at sample locations both upstream and downstream of the left-right-prong confluence. As an example, analysis of the surface water sample location MB-13 on the right prong of Molasses Bayou detected PAH constituents and a number of metals. PAHs and metals were also found at surface water sample location MB-10, which is downstream of MB-13 after the confluence of the left and right prongs of the Molasses Bayou Waterway.[31]

Surface sediment samples were also collected at locations associated with the Molasses Bayou AOI during the RI. In samples collected downstream of the BP Refinery, PAH, SVOC, and VOC constituents, metals, PCBs, TPH, and pesticides were detected in sediments. As noted above, effluent containing PAHs and metals were found in discharges from BP Refinery outfalls to the Molasses Bayou and Molasses Bayou Wetlands.[32]

Additional sampling conducted during the RI provides further support for a nexus between historical industrial wastewater discharges associated with the BP Refinery and contamination of both the Molasses Bayou Waterway and the Molasses Bayou Wetlands AOIs. To illustrate, PAHs and the same metals detected at

[25] Fact Sheet (R06-9716636), December 6, 1979.

[26] Fact Sheet (R06-9716636), December 6, 1979.

[27] USEPA, Region 6, *Record of Decision: Star Lake Canal Superfund Site*, September 2013, pp. 62–64.

[28] USEPA, Region 6, *Record of Decision: Star Lake Canal Superfund Site*, September 2013, pp. 1–3, figure 2.

[29] Conestoga-Rovers & Associates and Cardno ENTRIX, *Final Tier 2 Remedial Investigation Report*, August 2011, p. 43.

[30] Conestoga-Rovers & Associates and Cardno ENTRIX, *Final Tier 2 Remedial Investigation Report*, August 2011, figure 3-1.

[31] Conestoga-Rovers & Associates and Cardno ENTRIX, *Revised Draft 1 RI Report*, vol. 1, pp. 37–8, figure 5-4.

[32] Conestoga-Rovers & Associates and Cardno ENTRIX, *Revised Draft 1 RI Report*, vol. 1, pp. 42–3, figure 5-8A.

Part 7 – Nexus Summary
surface water sample location MB-13 were found at surface water sample location MB-49, which is downstream of the confluence of the left and right prongs of the Molasses Bayou Waterway. At surface sediment sample location MB-51, located in wetlands adjacent to the Molasses Bayou Waterway downstream of the left-right-prong confluence, PAH, SVOC, and VOC constituents, metals, PCBs, TPH, and pesticides found at surface sediment sample location MB-13 were detected.[33] These sample locations are shown on Figure 4-4 of the RI report. (attached) Based on, 1) effluent discharges containing hazardous substances from BP Refinery outfalls to the right prong of Molasses Bayou and wetland area, 2) the disposal of refinery solid wastes into the marsh proximate to the bayou and wetlands areas, and 3) the presence of PAHs, metals and other contaminants in the effluent and solid wastes, the BP Refinery would have contributed to the contamination present in the Star Lake Canal Superfund Site and the Molasses Bayou Waterway and Wetlands AOIs in particular.[34]

[33] Conestoga-Rovers & Associates and Cardno ENTRIX, *Revised Draft 1 RI Report*, vol. 1, figures 5-4, 5-8A; Conestoga-Rovers & Associates and Cardno ENTRIX, *Final Tier 2 Remedial Investigation Report*, August 2011, tables 6-1C, 6-2F.

[34] USEPA, Region 6, *Record of Decision*, pp. 62–7.

Part 8 – Corporate Succession and Relationships

The Atlantic Refining Company to ARCO

- On April 29, 1870, the Atlantic Refining Company incorporated in Pennsylvania. The Standard Oil Trust held control of the company from 1874 until its dissolution in 1911.[35]
- Effective January 3, 1966, Richfield Oil Corporation was merged into the Atlantic Refining Company. On May 3, 1966, the name of the company was changed to Atlantic Richfield Company.[36]
- On May 7, 1985, ARCO incorporated in Delaware as a successor to the company originally incorporated in Pennsylvania on April 29, 1870.[37]
- On April 18, 2000, ARCO merged with BP Amoco plc (now BP plc).[38]

Standard Oil Company of Ohio (BP Oil Corporation)

- On January 10, 1870, the Standard Oil Company (Ohio) incorporated in Ohio.[39]
- On January 1, 1970, Sohio acquired British Petroleum (Holdings), Inc. and amalgamated its properties with those of BP Oil Corporation, the major subsidiary of British Petroleum (Holdings), Inc.[40]
- In 1987, British Petroleum Company plc (now BP plc) acquired complete (95%) control of Sohio and merged it into BP North America Inc., a wholly owned subsidiary. With the merger, BP North America Inc. adopted the name, BP America Inc.[41]

[35] Moody's Industrial Manual, 1941, p. 2208.

[36] Moody's Industrial Manual, 1992, vol. 1, p. 80.

[37] Moody's Industrial Manual, 1992, vol. 1, p. 80.

[38] Mergent Industrial Manual, 2005, vol. 1, p. 402.

[39] Moody's Industrial Manual, 1972, vol. 2, p. 2536.

[40] Moody's Industrial Manual, 1972, vol. 2, p. 2537.

[41] Moody's Industrial Manual, 1989, vol. 2, p. 2654; Moody's Industrial Manual, 1990, vol. 1, p. 1015.

Part 9 – Acronym List
AOIs – Areas of Investigation
ARCO – Atlantic Richfield Company
CAS – carbon adsorption system
Lbs. – pounds
LPG – Liquefied Petroleum Gas
MNR – Monitored Natural Recovery
NOV – Notice of Violation
NPDES – National Pollutant Discharge Elimination System
NSPS – Standards of Performance for New Stationary Sources
PAHs – polycyclic aromatic hydrocarbons
RCRA – Resource Conservation and Recovery Act
ROD - Record of Decision
Sohio – Standard Oil Company (Ohio)
SVOCs – semi-volatile organic compounds
TCEQ – Texas Commission of Environmental Quality
TWC – Texas Water Commission
USEPA – United States Environmental Protection Agency
VOCs – volatile organic compounds